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BEET SUGAR.

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A Paper by F. A.

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BEET SUGAR.

ITS ECONOMICAL PRODUCTION IN THE PROVINCE OF QUEBEC.

A Paper by F. A. BARNARD, Esq., Director of Agriculture, Department of Agriculture, Quebec.

PART I.—BEET SUGAR.

Beet sugar may be called one of the productions of this country; and it is not one of the least fruitful inventions of this wonderfully inventive age. In 1747, Margraff, a distinguished German chemist, made known to the world, for the first time, that several root plants contained sugar amongst which is the beet. However, it was only in 1796 that the first efforts to manufacture beet sugar were made by Ch. François Achard, disciple of Margraff. These efforts proved successful, and several manufacturing factories were started in Germany, at the beginning of this century. A book was published on this subject by Achard, in 1812, giving such lucid information on the whole question that it took nearly half a century before more light could be brought on it. Achard's writings on the economical production of beet sugar in Europe must have been very effective indeed, since several continental governments at once took up the subject. Napoleon the First, who, by his peculiar genius, foresaw clearly the political use to be derived from this source, gave the greatest impetus to the new production, which received an additional assistance from the fact of the continental blockade, against England, of most continental ports in Europe. Even Russia paid as much as 50,000 roubles to assist in the establishment of the first beet sugar factory in that country. France lavished its millions of francs for the same purpose, and the different States of Germany offered and gave all the assistance they could to similar establishments in their respective provinces. Even England seems to have taken fright at the continental efforts to ruin its colonial trade in sugar, for it is stated on good authority that Achard was offered \$30,000 at first if he would only state, in print, that he had been mistaken in his assertion that beet sugar could be economically produced. And as early as 1811 this offered bribe was increased to \$100,000, but it was again scornfully rejected by the proud but honest German, in the interest of humanity. It would seem that England's spite could not be hidden, and that somewhat later, Sir Humphrey Davy was induced to state in his "Treatise on A-

cultural Chemistry," that beet sugar was *entirely too bitter* to be of any use. The discussion must have been *bitter* indeed—but not so the sugar, which, when refined, is identical to the very best cane sugar; so much so that the ablest chemist or commercial buyer in the world could not, in the presence of samples of each kind, say which is which, were it to save his life.

Napoleon I has been justly called the father of this industry. He lavished both honors and fortune on those who were the most successful in its establishment,—but his downfall nearly ruined this offspring of his. The alliance of continental powers with England against France, brought back the predominance of England's commercial interests on the continent—and the very elastic principles of free trade nearly crushed this industry entirely out of existence. Although Germany and Russia had already lavished millions of francs in the manufacture of beet sugar, they allowed the imported cane sugar to compete fully with the beet sugar, which, being yet unable to support this competition, was completely ruined in all countries but France.

Even in France, for many years, the theories of free traders had their able and nearly all-powerful defenders; so that beet sugar could barely keep up a foothold. So was it in France up to 1829, when the whole production of beet sugar did not exceed 4,000 tons annually, although millions over millions had been lost in the attempt to establish this industry without sufficient protection in its infancy. It would no doubt prove interesting to follow out this all but deadly combat between free trade and protection in France, on this question of beet sugar.

However, I will only say that to me it looks as if a few very clever, if not always very honest men, managed to enrich themselves and their friends, but not without impoverishing the mass of agricultural laborers. To perform this clever trick requires great ability, indeed, in handling bright, dazzling theories, which, like a mirage, can, of course, deceive people. But yet, those clever things could not be repeated,—and accomplished again—were it not for that very numerous class of so-called statesmen, who, in order to maintain their prestige, are always in search for the easier and least unpopular mode of taxation, if not the most judicious and most encouraging system for the fostering of home industries. Thus, in France it was feared that the maritime commerce of the country would suffer by the stoppage of importation of colonial sugar, the total consumption of which then only amounted to 35,000 tons. Protection was established notwithstanding the gloomy predictions of the free-traders; let us see what was the result:

Instead of the 4,000 tons of beet root sugar manufactured in 1829, France now produces from 300,000 to 462,000 tons per annum. It, however, imports about 200,000 tons of sugar annually. Its consumption has increased from 35,000 to 266,384 tons per annum (1876). All this sugar is refined at a profit to commerce and industry, and France exports about 450,000 tons every year. The free-traders were therefore wholly mistaken

in their calculations. 35,000 tons of the interests of and French colonies both in France

To this must be added coal, which are the numerous in their turn,

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in their calculations. They wished, at any price, to retain their trade of 35,000 tons of foreign sugar, and to this end were quite willing to sacrifice the interests of home industry and of agriculture. The latter prevailed, and French commerce now handles about 860,000 tons of sugar annually both in France and in foreign countries.

To this great commercial movement, created by the new industry, must be added the carriage and consumption of about 2,000,000 tons of coal, which are annually used in the manufacture of sugar in France, and the numerous other industries which support thousands of families who in their turn, create new sources of wealth.

It is established beyond a doubt that France would have been unable to free itself so easily from the terrible consequences of the last war, without the assistance of the immense agricultural wealth of the whole country due principally to the beet root sugaries in the north, and vine-growing in the south.

It will be interesting to recall, in a few words, the different phases of this, protection to the beet-root-growing industry in France since 1820. I cannot refrain from here giving the following extract on this question from Mathieu de Dombasle, France's greatest agriculturist of the age, and one of its best patriots. In discussing this very subject of the national importance of fostering the sugar beet industry, he said, in 1829:

"France produces but a small proportion of the sugar consumed in the Kingdom. However, the increase in production has been so rapid within a few years, and so many manufactories are being opened, that it is easy to foresee, if nothing happens to deaden this movement, that it will not take many years before France can suffice to itself in this production. It is somewhat remarkable that this industry has taken root only in France and in Germany, where the manufacture of beet sugar had its first beginning—where it had taken a considerable extension, under the impulse of the continental blockade, it was completely crushed out, by the free competition of the sugar from the Indies." He says further: "It is probable that a nation conveniently situated for this industry, and which will have secured its foothold in the country before other nations can do so, may later—perhaps for many years—not only suffice to its own consumption, but also sustain a successful competition against foreign sugar even in foreign markets." I may here say that in Canada the question of any further protection to this industry can never arise, since the protection in favor of beet sugar factories would be enormous, and more than was ever asked for in Europe. Imported sugar pays a duty of 45 per cent. of its value and costs at least from 10 to 12 per cent. for import charges, which would give the manufacturer a safe protection of more than 55 per cent.

M. de Dombasle then goes on to show how favorable the new industry would become to agriculture in general, and how much it was for the interest of the whole French nation, and therefore of the French Government, to give to beet sugar factories the encouragement necessary to the

solid establishment. He also demolished entirely the arguments to the contrary, advanced with great success up to that time, by a whole school of free-traders in France, of which the french economist Say, was the head.

Let us now see how far Mathieu de Dombasle's prognostications in 1829 have proved correct. In 1836, seven years after the writing above cited, the production of sugar in France, which was only 4,000 tons in 1829, increased to 40,000 tons. In 1857 it was only 49,000 tons. About this time Napoleon III. turned his attention to this subject. His support met with the greatest success; a reasonable protection was secured, and the following results were attained:—In 1862, 170,000 tons of sugar were made in France; in 1867, 275,000 tons; in 1871, 396,000 tons; in 1875-76, 462,259 tons; or an increase of nearly one hundred and twenty-five-fold in forty-seven years, for France alone.

We have seen above, that, up to 1830, no beet sugar factories existed in Europe elsewhere than in France. The writings of M. de Dombasle and others of the same school, created a stir in Belgium, and then in Germany, with the following results:—

Quantity of beet sugar produced in Europe (in tons).

	1876-7	1875-6	1874-5	1873-4
Germany.....	280,000	340,645	250,708	289,243
France.....	225,000	462,259	450,877	396,576
Russia.....	250,000	245,000	222,500	202,851
Hungary.....	150,000	153,922	120,720	167,058
Belgium.....	55,000	79,796	71,079	73,516
Holland	30,000	30,000	30,000	30,000
	990,000	1,317,622	1,145,881	1,162,246

showing an increase of beet sugar production, in forty-seven years, of three hundred and thirty-fold.

But what is more surprising still, and what does not seem to have been expected by any of the writers of that epoch, is that the consumption of sugar seems to have increased in the same enormous ratio as the production:—thus in France, in 1829, the consumption was 35,000 tons, or about 2½ lbs. per head; it is now 265,000 tons, or 16½ lbs. per head. In England, in 1844, the consumption was 236,143 tons, or about 16 lbs. per head; it is now, including molasses, 900,000 tons, or about 62½ lbs. per head.

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The following table, giving the consumption of sugar in different countries, may prove interesting :

	Tons.	Population.	Per head.
Great Britain.....	900,000	31,629,300	62.58
Germany.....	315,000	42,753,900	16.19
France.....	275,000	36,377,600	6.51
Russia.....	250,000	82,135,700	6.70
Austria.....	170,000	20,395,000	18.33
Spain.....	50,005	16,835,000	6.50
Belgium.....	50,000	4,827,800	22.65
Holland.....	30,000	3,579,400	17.50
Turkey.....	25,000	23,610,000	2.25
Sweden and Norway.....	20,000	5,870,300	7.05
Portugal.....	15,000	4,324,000	7.05
Denmark.....	15,000	1,785,000	18.25
Switzerland.....	11,000	2,659,600	9.00
Greece.....	3,000	1,457,100	4.59
Europe.....	2,120	3,243,200	17.00
United States.....	75	925,000	42.35
British Colonies.....	200	30,000	8.08
Total.....	3,079,000	361,168,200	17.05
Canada.....	82,461	4,365,000	39.05

The total production of beet sugar and of cane sugar, in 1874, was as follows, for all sugar manufacturing countries :

Total cane sugar manufactured, in 1874, 1,840,986 tons ; do., do., beet sugar, 1,110,166 tons. Total, 2,951,152 tons.

It will, no doubt, be observed that all countries producing sugar, either by themselves or their colonies, use a great deal more sugar than other countries, except, however, our own country, which proudly stands as third on the whole list, although it produces none other than the maple sugar, which does not enter into the above table of production and consumption, and which, however, if counted, would very likely place us second on the list if not the very first.

II.

EFFECT OF THE BEET-SUGAR INDUSTRY ON AGRICULTURE.

Let us now examine briefly the wonderful effects of this industry on the agriculture of all the countries where it has been implanted. This would apply to Canada in the highest degree if sugar beets were produced. I say in the highest degree, since the production of beet roots necessary for this industry, by cleansing our land and exacting a more careful cultivation, would not fail to increase three and four-fold the agricultural produce of those portions of the country which would supply the factories.

In 1850, in France, fears were entertained at what was then considered the wonderful increase of beet culture for the production of sugar. It was believed by many that this increased production of beets would cause a proportionate decrease in that of cereals. A legislative enquiry was consequently ordered, and the following facts clearly proved:—The district of Valenciennes, in 1813, (one of the best cultivated in France) produced about twenty bushels of wheat to the acre; in 1833 it produced thirty-two bushels. Before beet culture was established, the whole production of wheat was 40,000 bushels; it rose (in 1833) to 1,192,000 bushels, an increase of over 30 per cent. In 1822 the whole district fed 400 oxen; nine years later (in 1831) it fattened 10,784, or an increase of over 25 to 1.

The following is equally extracted from an official document published by the French Government in 1873:

"There exists in the north of France a certain number of districts which have attained the maximum of agricultural production. Thus, in favorable seasons, these localities produce an average to the acre of 38 bushels of wheat; of 22½ tons of beets; of 330 to 380 bushels of potatoes. c. What causes this prodigious prosperity? In some parts it is due to the use of Flemish manure, which agriculturists from the north have utilized for centuries; in others where human feces is not collected, it is entirely due to the production of beets. It has been repeated on all sides, and yet it cannot be too much said: the cultivation of beets is that which has contributed most to agricultural progress."

I might give page after page of similar statements, not only from French authorities, but also from all the countries where this wonderful industry exists. However, the tables given above speak higher in favor of beet sugar than all I could say. It is everywhere shown that the several crops have tripled on an average, wherever the soil has been cleaned by the beet crop, and manured by the enormous quantity of cattle necessary to utilize the remains of the beet, after the sugar has been extracted from it. It has been conclusively shown that the increase in cattle in these regions has been at the rate of over 25 to 1.

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Mr. Telesphore Bran, who wrote a pamphlet on the "Foundation in Canada of the manufacture of beet sugar," thus epitomises correctly the following advantages offered by this industry. He says: "An enlightened practical study on the subject, of half a century, shows in the most conclusive way:—

" 1st. That the cultivation of beets, far from impoverishing the soil, vastly increases its fertility, by the production of an abundant supply of manure.

" 2nd. That by the very many plowings, harrowings, hoeings, &c. indispensable to this crop, the land is prepared in the very best manner for the crop which follows.

" 3rd. That this hoed crop enables the farmer to follow the best and most rational system of rotation for his farm.

" 4th. That not only does the sale of the beet to the sugar factory cover the whole cost of the production, and of the cleaning and manuring of the soil for future crops, but that generally it brings to the farmer a large cash return per acre than any other crop he could raise.

" 5th. That it enables the farmer to obtain in summer the assistance of a great number of hands, who find a profitable occupation, at the manufactory, for the whole of the winter; thus creating a better market for farm produce, and generally a source of wealth to the country which can hardly be overestimated."

[I may here add that Mr. Cuisset, the chemist attached to our Department of Agriculture, has published an excellent little popular treatise on the cultivation of beet roots and the manufacture of sugar in Canada, which will be read with interest by all who wish to be posted on the elements of this important question.]

Before leaving this part of my subject, it may be useful to say a word of the refuse from the beets after the sugar has been extracted. This refuse is called pulp; it is generally in cakes, and weighs about 22 per cent. of the original beet. Its feeding value is somewhat greater than that of beet—containing, as it does, all the fibrous matter, besides a large per cent. of sugar, and less water than in the beet. Although it would be useless to enter here into any of the details of the manufacturing process, it may be well to explain how it is that the residue is richer than the original beet. Good sugar beets contain from 10 to 16 per cent. of sugar, about 80 per cent. of water, the rest is fibrous matter, salts, &c. The sugar in the juice is contained in millions of small cells, which are partly broken up by the grating process to which the beets are subjected—a quantity of water, varying from 15 to 20 per cent., is also added to the mass, and the whole is subjected to an immense pressure, when a large proportion of the sugar is removed in the juice, and the rest remains in the cake; but, as it takes about five tons of beets to one ton of refuse, it is now easy to understand how this refuse may have a larger percentage of nutritious matter than is contained in the beet.

Numerous practical tests have shown, in the most conclusive manner, that for feeding purposes the beet refuse, or pulp, is worth about one-third as much as the best hay. That is, three tons of refuse equal one ton of excellent hay.

The sugar beet crop in France produces on good land, with high culture, an average of about 30 tons per acre. In Germany, the average under similar circumstances is about 20 tons, but the beets are much richer than in France, and more sugar is produced per acre than in France. In Germany an acre of good beet roots gives an average of from 2,800 to 3,000 pounds of sugar. Considering the average of beet roots produced to be 20 tons to the acre, the refuse in pulp would be equal to about two tons of the best cured hay per acre.

The farmer, after having sold his beet roots with profit, and after having sowed hoed crops which will cause an extraordinary improvement to be felt in subsequent crops, will have, as an additional source of profit, the nutritious value of two tons of hay per acre—that is to say, much more than is produced by our good meadows. This should be sufficient to prove in the most convincing manner all the importance of the introduction of this industry, even from a purely agricultural point of view. From an industrial and commercial standpoint, a most necessary commodity would be produced which we have now to purchase in foreign parts, at the cost of about six millions of dollars, besides import charges, customs duties, &c., &c., which increase the price of imported sugar in Canada to the enormous figure of ten millions of dollars. (See official tables further on.) This is the sum which would be retained in the country; which would be circulated in trade; would support thousands of families, and would, in its turn, produce new and considerable wealth. Who knows if we may not be able to produce a surplus over and above the quantity required for our consumption, which, becoming an article of export, will be an additional source of riches?

Besides, to produce this sugar in this country we would use 230,000 tons of coal, which would give a great impulse to the development of our coal mines in the Maritime Provinces, and give rise to considerable transportation.

AMOUNT OF

Kind.

No. 9 Sugar (Dutch
and above).....
Sugar below No. 9.....
Syrup, &c.....
Candied sugar, confec
Molasses.....

Total

SUGAR, SYRUP
ending

Sugar above No. 13
" " " 9
" above No. 9.
Melado.....
Sugar cane, Syrup,
Candied Sugar and
Molasses.....

Total

Corresponding num
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Increase during the

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AMOUNT OF SUGAR, &c., consumed during the past five years.

Kind.	1875-76.	1874-75.	1873-74.	1872-73.	1871-72.
	lbs.	lbs.	lbs.	lbs.	lbs.
No. 9 Sugar (Dutch standard and above).....	95,298,980	82,617,733	85,452,194	76,970,935	61,249,713
Sugar below No. 9.....	19,855,326	18,199,153	16,469,485	15,060,540	13,507,312
Syrup, &c.....	4,605,398	3,965,967	3,012,925	2,492,099	2,958,552
Candied sugar, confectionery, &c.....	459,035	520,440	461,908	331,353	273,362
Molasses.....	49,471,307	44,063,653	52,728,700	43,212,324	44,947,932
Total.....	163,981,518	149,366,955	164,125,212	138,067,251	122,936,871

SUGAR, SYRUP, AND MOLASSES consumed in Canada during the year ending 30th June, 1876. [Extract from the official report.]

Kind.	Quantity.	Value.	Duty.
	lbs.	\$	\$ cts.
Sugar above No. 13 (Dutch standard).....	75,443,654	3,640,323	1,664,516 62
" " 9 to 13, inclusive.....	19,855,326	768,277	340,988 45
" " above No. 9.....	14,146,798	444,510	181,862 25
Melado.....	2,492,569	82,629	30,004 13
Sugar cane, Syrup, &c.....	2,112,829	69,200	35,508 26
Candied Sugar and Confectionery.....	459,035	69,026	21,846 82
Molasses.....	49,471,307	935,828	233,957 29
Total for fiscal year 1875-76.....	B. 163,981,518	\$6,009,793	\$2,503,683 82
Corresponding numbers for fiscal year 1874-75.....	149,366,955	\$5,918,665	\$2,450,769 98
Increase during the past year.....	14,614,563	91,128	52,913 84

III.

CAN BEET SUGAR BE PRODUCED IN CANADA AT A PROFIT ?

I now come to the important question : — Can beet sugar be produced in Canada at a profit ?

This question it has been my duty to study out. In 1870 I was sent over to Europa by the Government of Quebec, and later by the Federal Government, with a special mission, an important part of which was to report on this very question. Although I had read somewhat on the subject, yet its practical working was new to me, and I found it necessary to look most closely into the whole matter. For this purpose I consult

the best authority in Europe, and passed, at one time, a whole month at Tembloux, in Belgium, conferring with the heads of the Belgian Government Agricultural College there. I visited also the country surrounding, all of which is interested in beet sugar production, which at that time created such a *furor*, that the number of manufactories was about doubled in Belgium within two years, from 1871 to 1873. One factory existed already at Tembloux, but two others were being constructed, with a manufacturing capacity each about three times as great as that already existing. I spent about eighteen months in Europe, and visited a considerable number of establishments, both in Belgium and Germany, the processes there followed being considered much better than those of France, which, at that time, was just issuing from a most calamitous war, which had completely paralyzed all its industries, as well as the manufactories of beet sugar. On my return a report was published, in which I advised making experiments as to the successful production of sugar beets in this country, both as regards quantity and quality.

Respecting the manufacturing process in Canada, I have come to the conclusion that with the necessary capital, appliances, and experienced management, we can manufacture the sugar here for a very small, if not an insignificant increase over the cost of production in Europe. Which is from 4c to 6c, according to circumstances, for refined sugars. On this I am happy to state that my views are supported by several European gentlemen well cognizant with the subject, and who have visited this country most carefully. If, on the one hand, labor is more expensive here than on the continent, and perhaps coal also, (although this latter question is not quite proved, since coal can be obtained in Quebec at the rate of from \$4.00 to \$4.50 per ton of 2,240 lbs.,) yet the labor question is a very small consideration if it be remembered that about 100 hands will run out in 24 hours, with the best appliances, about 20,000 lbs. of sugar worth \$1,600 at 8c. (this sugar, at the present market prices, would be worth, wholesale, 11 or 12 cents, or produce \$2,200 to \$2,400.) I must leave out many incidental questions which I cannot enter into here, but which will, I believe, bear me out in the above statement.

A factory of eight presses will produce, in 150 days, about 3,000,000 of sugar, or 20,000 lbs. per day.

But I must say that we possess an advantage that no other country possesses. Whilst in Europe factories cannot be worked profitably, as a rule, over 100 days, here, on account of our special climate, we can work with certainty over 200 days. Thus, if the profit on the manufacturing of beet sugar in Europe be 33 per cent., which has been the case until within the two last years previous to this, we could obtain the same percentage,—even if our profit be 16½ per cent. on the beets manufactured, we can work with this same capital at least double the amount of beets. Our long winter seasons, that they can in their exceedingly short winters. In fact, this year the great complaint in Europe is want of cold weather; beets vegetated and lost their saccharine qualities to such an extent that the large increase in the price of sugar hardly covered the loss in the

saccharine value and 1876, the price and other causes 40 to 50 per cent. possesses an inventory there would be ventilated out-few beet-growers old saying: "I taking a still Creator's work can understand

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saccharine value of the beet. I may here state that during the years 1875 and 1876, the prices of sugar came down with a crash, from over-production and other causes too long to explain, but the prices have again risen from 40 to 50 per cent. Whatever may be said against our cold climate, it possesses an invaluable advantage to the beet sugar manufacturers, who, there would be quite sure that from the 15th of October to the first of May, there would be no danger of the beets growing, if placed properly in well ventilated out-door cellars. This is really an immense advantage which few beet-growing countries possess; it shows once more the truth of the old saying: "It's an ill wind, indeed, which blows nobody good"—and taking a still higher view of the subject, it reminds us again that the Creator's works are all eminently wise, and eminently useful, too, if man can understand their full value.

Now, I need not tell you that ordinary beets grow well here, everywhere, in properly cultivated soil which can produce good hay and grain crops. But perhaps few farmers are aware that sugar beets also do remarkably well here. Hundreds of reports have reached me this year, in my official capacity, from forty different counties, all of them quite satisfactory with perhaps one or two exceptions only. But what caused me some surprise is the fact that so many report the sugar beet as easier grown and with more satisfaction, in every way, than even the hardy mangold wurzel. As to feeding qualities, there seems to be no doubt that a ton of good sugar beets is fully worth two tons of mangolds, and yet I have many returns showing a produce of from 30 to as much as forty tons per acre of good sugar beets. So much for their profitable cultivation in Canada.

It is a fact, admitted by all manufacturers of sugars, that the beet root has a greater value in proportion to the quantity of sugar it contains, and to the higher degree of purity of the juice which it gives. Thus, putting the commercial

VALUE PER TON OF SUGAR BEETS CONTAINING 9 PER CENT. OF SUGAR

in the juice with a purity of.....			at	
9 per cent. of sugar	"	85.7	"	\$3.72
10	"	66.6	"	2.72
10	"	87.	"	4.54
10	"	70.	"	3.47
11	"	88.	"	5.54
11	"	71.6	"	4.52
12	"	89.	"	6.37
12	"	72.1	"	5.39
13	"	89.6	"	7.27
13	"	74.	"	6.26

by which it clearly appears that a careless farmer will produce beet hardly worth \$2 a ton, for many beets do not contain 9 per cent. of sugar, whilst the careful producer, who follows the dictates of experience, will produce beets worth over \$8 a ton for the production of sugar.

IV.

VALUE OF THE SUGAR BEETS PRODUCED IN CANADA, AND CONCLUSIONS.

Now we come to the point: What is the saccharine quality of our province of Quebec sugar beets? The answer I am going to give you is official, and little known outside of the Department of Agriculture in Quebec. Some trials and analyses of beets have been made from year to year; but, unfortunately, from want of the proper experience, the beets cultivated previous to this year proved rather poor in sugar. This fact we now was due to want of care in the cultivation of the beet, on the part of the farmers, and also, to a degree, from inferior seed.

Last year the department imported what was guaranteed as excellent seed. It was distributed through the members of Parliament, in most cases, but, unfortunately, rather late in the season by most. This distribution was accompanied with printed instructions, insisting in the most pressing terms on the special mode of culture necessary to the production of the best sugar beets.

In the fall, circulars were again issued, from the Department, requesting that samples be sent of the beets cultivated, with answers to several questions therein contained, relating to the mode of culture, of manuring, the time of seeding, of cropping, &c., &c. Several hundreds of answers were sent in, accompanied by about 300 samples of beets. Out of these, 15 samples have been carefully analyzed by Mr. Octave Cuisset, a special chemist attached to the Department, who has had an experience of many years in the practical manufacturing of beet sugar, both in Belgium and France, and who actually manufactured some coarse unrefined sugar from Canadian beets, merely to show he understood the business.

In order to maintain the most convincing proof possible as to the value of the analysis made in our department, we sent over twelve samples each to France and to Belgium for analysis, to the best recommended special chemists in these countries gentlemen who have now been consulted for the last three years by the Department of Agriculture. These samples sent to Europe were selected out of similar lots produced on twelve different farms in various parts of the Province; they were all numbered carefully, and many weeks before the answers came over from France and Belgium, caused to be published and printed, in the Department report of 1876, the analysis made here on the same lots as those sent to Europe. We subsequently received answers from France and from Belgium.

What are the results? I will say that they deserve our most careful consideration. They are:

Firstly. That the various analyses made in France, in Belgium and in Quebec, on the twelve identical lots above mentioned, hardly differ at all—more than could have been expected from different beets grown in the same field—proving that our analysis are entirely to be trusted.

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Secondly. That the system of cultivation followed here this year has been by no means perfect, and that, in consequence, a still higher degree of richness in the beet can be attained.*

Thirdly. That notwithstanding our inferior mode of cultivation, the Quebec beets, as a whole, are considerably richer than the average obtained this year either in France or in Belgium.

I will now give a few extracts from the above-mentioned official reports from France and from Belgium.

Extracts from the report made by M. de Puydt, Chemist, of Brussels

"This lot of beets (of 1876) is the third we received from Canada, and we can state that they are much better than those sent us last year * In this last lot, the roots, with one or two exceptions only, are all of excellent type; two or three are rooty and forked, and were grown rather too much out of the soil. This may depend on some local condition which we ignore. At all events, a better preparation or mellowing of the soil and deeper culture will no doubt remedy this evil."

"The degree of purity representing the proportion of foreign matter, sugar contained in the juice, has attained an average of 81.05 which is excellent."

"The percentage of sugar in the juice is 12.89 per cent. which is a very good, in beets weighing two pounds and a-half. These figures show conclusively that the seed sown was good, and also that Canadian soil is eminently fitted (*essentiellement propre*) to the cultivation of the sugar beet on the condition, necessary everywhere, that it be properly prepared, and that the variety of seed sown be carefully selected."

(Signed,) JULIEN DE PUYDT

"Brussels, 15th January, 1877."

I will now give the concluding remarks of the French chemist report, Mr. L'Hôte, who says: "The Canadian beets of 1876 have given by analysis, an average of 12.45 of sugar for 100 parts of juice."

The conclusion to be drawn from the information already supplied is, that the season of 1876 has not been favorable to the cultivation of roots in Canada. In France the state of things was the same.

* The hope we expressed last year has been completely realized in this, after new assays in five hundred different localities. Thus, instead of having an average (excellent in itself) of 76 of sugar per cent. of the juice, with a quotient of purity equal to 76, we have this year an average of 13.22 of sugar and a quotient of purity equal to 83. This difference may be estimated as follows: Supposing the average of the beets analyzed by our department last year to represent a money value of \$3.72 per ton, those analyzed this year would be worth \$4.40, or an increase of over 20 per cent.

"The average saccharine quality of the Canadian beet is superior to that obtained in France."

"The average obtained in France for the present year is 10.30 per 100 parts of juice."

"In France the head of the beet is thrown aside as refuse, and does not enter into the manufactory of sugar."

"In the Canadian beets, this refuse amounts to 8 per cent. of the whole weight of the beet, but we have found that even these contain 10.22 per cent. of sugar in 100 parts of juice."

"(Signed.) DESIRE L. L'HOTE, Chemist.

"Paris, 24th January, 1877."

These very favorable reports are confirmed by Mr. Champion, the chemist employed by the eminent manufacturing firm of Fives-Lille, to whom we owe a debt of gratitude for the cordial and earnest help they have given us during many years.

We have now an opportunity of stating that Mr. Octave Cuisset, a Belgian chemist attached to our Department of Agriculture, is deserving of the greatest praise for the scientific and practical knowledge he has brought to bear on the study of everything that relates to the future of this industry in this country. Let us hope that the most complete success will be the reward of such perseverance and such devoted labour.

This report thus shows that our Canadian beets are over 20 per cent. richer than the French beet, and that our refuse heads of beets are as rich, nearly so, as the better parts of the French beet.

In presence of these facts, it seems very evident that this question of production of beet sugar in Canada is of national importance, and that, from an agricultural point of view, it is perhaps the weightiest problem which we, as agriculturists, or patriots, can be called upon to work out to a favorable issue. Let it be remembered that we can grow beets here as cheap as in Europe, that Canada import annually about 165 millions of pounds of sugar and molasses which cost, laid down here, over ten millions of dollars. Also consider that the manufacturing of this quantity of sugar would necessitate the establishment of over fifty large sugareries, employing work in one way or another to 15,000 men, besides the farmers; that it would enable the farmer to grow annually, with great profit to himself, and with great advantage to the country around, 50,000 acres of beets, at 20 tons per acre; that it would produce annually 282,000 tons of sugar or beet pulp, which would cost nothing to the farmers and yet would be worth as much to them as 71,000 tons of hay; that it would enable us to keep four times more stock on our farms, quadruple our

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barn yard manures, besides enabling us to purchase an abundant annual supply of artificial manures, which would all be paid by the beet crop and leave a large profit.

In presence of these facts I may well say that the day when a factory of beet sugar will be established in the Province of Quebec will be a happy day for us all, and that it behooves all of us and every farmer in this Province, to study out this question carefully for himself. If what I have here stated is correct, and I can vouchsafe for the correctness of each and every one of the above statements,—I say, if what I have stated is correct it becomes the duty of every patriotic Canadian to work earnestly and well in fact to leave no stone unturned until this object, of such national magnitude from an agricultural point of view, be successfully attained.

I may here say that our Local Legislature so well understands the importance of this matter, that as far back as 1874 it passed a law offering \$25,000 as a premium to the first successful manufactory of beet sugar in this Province, and that in 1875 this premium was increased to \$7,000 annually for ten years, which is equal to the sum of \$70,000.

However, I must say that the manufacturing of beet-root sugar is of a very complex nature, that it requires the ablest chemists and practical men of highly scientific attainments before it can be carried out with success. And what is still more difficult to attain perhaps, it will require especially for the first start, a very large capital indeed, which, I am afraid will amount to \$350,000 in order to secure success. This estimate supposes that the company would undertake to produce itself two-thirds of all the beet-roots required by the factory. This is the system usually followed in Germany, Austria and Russia. If the farmers undertake to produce excellent beet-roots for the factory, in sufficient quantity for all its wants, the required capital in that case should not exceed \$200,000 for the first factory producing 110 tons per diem, and probably \$125,000 for all succeeding ones. On the other hand, from all the information I can gather, and I think I have gathered a good deal on the subject, no industry in Canada will ever have given such a large return, for the amount put into the enterprise, if only properly conducted.

The capital above mentioned would not only suffice to produce marketable white sugar, but also would cover all the necessary outlay for the production of the beets needed by the factory, leaving an ample margin to meet all unforeseen contingencies.

Before concluding, I deem it necessary to say one word on the subject of refineries. Many persons are of opinion that the difficult position in which our refineries have been placed by the strictures of the tariff and the drawback given to American refiners, would prove equally disastrous if not ruinous, to the Canadian beet-sugar manufacture if the industry were established in the country. This is a great mistake. The refiner has to import his sugar, on which he pays 25 per cent. duty, *ad valorem*, and 3 per cent one cent per pound according to quality, before he can begin his operations.

whilst the merchant imports refined sugar at 25 per cent. *ad valorem*, and one cent per pound. The only margin for profit, therefore, is on the refining of sugar which pays $\frac{2}{3}$ of a cent per pound in addition the 25 per cent. *ad valorem*. Now, if the American refiner really gains one cent per pound by the present system of American drawbacks, which is generally believed, it is easy to see that he can afford to sell his refined sugar at almost the same price as unrefined sugar. This explains the difficult position in which the Canadian refiner finds himself.

But not so the beet sugar manufacturer, who would have no duty whatever to pay, who can produce a merchantable article of excellent quality, and who would benefit to the extent of the whole amount of 25 per cent. *ad valorem* duty and the 3-5 of a cent on imported sugar, besides the cost of importation, which amounts to about 10 or 12 per cent. on the invoice price. A protection which, as before stated, is equal to about 55 per cent. on the invoice price of sugar in foreign countries.

I may say that this essay is almost the same as that which I published in the *Journal of Agriculture*, with the exception of some useful information which I thought proper to add.

EDWARD A. BARNARD,

Director of Agriculture.

Quebec, 1st November, 1877.

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